UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN GEOSEARCH, INC.,

Plaintiff,

v.

TC ENERGY CORPORATION,

Defendant.

Case No. 2:20-cv-12600-SDK-APP

HONORABLE SHALINA D. KUMAR

MAGISTRATE JUDGE ANTHONY P. PATTI

PLAINTIFF'S EXPERT REPORT:
OPINION OF NETHERLAND, SEWELL & ASSOCIATES, INC.

NETHERLAND, SEWELL & ASSOCIATES, INC.

EXPERT OPINION REGARDING GAS MIGRATION FROM MUTTONVILLE GAS STORAGE FIELD TO THE PILAT 1-24 WELL
APRIL 14, 2022

Netherland, Sewell & Associates, Inc. (NSAI) was engaged by Sommers Schwartz P.C. (the Firm) on January 12, 2022, to perform expert consulting petroleum engineering, geological, geophysical, petrophysical, and evaluation services in connection with the Firm's representation of Michigan GeoSearch, Inc. (MGI). Services provided include the preparation of this Expert Opinion.

For the purposes of this report we have conducted a review of the available engineering, geochemical, and geological data in and around the Pilat, Francis 1-24 (Pilat 1-24) well and the adjacent Muttonville Gas Storage Field (Muttonville GSF), located in Macomb County, Michigan. The Pilat 1-24 well is operated by MGI, and Muttonville GSF is operated by ANR Pipeline Company (ANR). The purpose of our review is to provide an opinion as to whether any of the gas volumes injected into Muttonville GSF migrated away from the storage field and into the reefal development located in the Pilat 1-24 area, outside of the Muttonville GSF boundary.

For the purposes of this report, we used technical data including, but not limited to, well logs, geologic maps, seismic data, gas analysis data, and production data. The available data allowed for a multitrack approach, thus we employed the following three approaches (1) reservoir engineering analysis of well pressures and volumes through time, (2) geochemical analysis comparing the native Niagaran gas composition with the composition of the stored gas at Muttonville GSF and the gas produced by the Pilat 1-24 well, and (3) geologic analysis of potential migration pathways and in-place volumes. Based on the data reviewed, it is our expert opinion that it is more likely than not that (1) some of the gas volumes injected into Muttonville GSF did migrate away from the storage field and into the reefal development located in the Pilat 1-24 area, and (2) a portion of the gas produced from the Pilat 1-24 well is a result of that gas migration.

RESERVOIR ENGINEERING ANALYSIS

Pilat 1-24 Production History and Observations

The Pilat 1-24 well was drilled by Reef Petroleum Corporation in February 1977 and was completed March 1, 1977. As shown in the table below, the Pilat 1-24 well has been allowed to produce during four periods of time.

Period		Duration	Gas Production (MMCF)	
Beginning	End	(Years)	Period	Cumulative
6/1978	9/1985	7.3	541.1	541.1
8/1990	6/1994	3.9	176.5	717.6
7/2001	12/2013	12.5	446.1	1,163.6
4/2017	6/2019	2.1	39.8	1,203.4

Totals may not add because of rounding.

Gas volumes are expressed in millions of cubic feet (MMCF) at standard temperature and pressure bases.

The historical pressure and gas rate for the Pilat 1-24 well are shown in Figure 1. The four production periods tabulated above can be seen on the graph, and we can see from the data shown in Figure 1 that repressurization occurred between the production periods. Repressurization can be caused by a number of factors, including delayed gas dissolution from tighter zones, gas migration from tighter portions of the subject reservoir, and gas

migration into the structure from an external source. The longer repressurization continues, the more likely it becomes that gas migration into the structure from an external source is a contributing factor.

Inventory Verification

Gas storage operators keep an accounting tally, known as the booked inventory, of the gas volumes stored at a facility. These tallies can be kept daily or monthly. The booked inventory starts with the inventory at the beginning of a period and adds the volumes injected over the period. Volumes withdrawn are subtracted, as are known losses such as fuel usage. The result is the final booked inventory for the period. This is a purely arithmetic tracking of inventory.

The final booked inventory does not account for unknown losses. During storage operations, these unaccounted-for losses can include:

- Losses from the surface facilities,
- Subsurface losses from wells,
- Subsurface migration out of the storage reservoir,
- Subsurface migration to less connected or ineffective portions of the reservoir,
- Losses due to inaccurate metering or accounting, and
- Gas produced by other parties.

If system losses are ongoing and not accounted for, then the booked inventory will become an increasingly poorer reflection of actual in-place inventory. To prevent this, most operators will periodically perform an inventory verification exercise. The inventory is estimated by other methods and checked against the current booked inventory. Three of the most common methods of estimating inventory are numerical modeling, production-pressure analysis, and volumetric calculation. Accounting adjustments to the booked inventory are made if the deviation between the inventories warrants such adjustments.

Total inventory is typically composed of two parts, working gas and base gas. Working gas is the total cyclable volume for a season. Base gas, also known as cushion gas, is the volume of gas that remains in the storage reservoir. Base gas expands and remains in the reservoir and thereby provides the energy (or spring) to achieve the required deliverability. Base gas is not produced; however, a portion of the base gas could be recoverable if the field were blown down and abandoned.

In addition to working and base gas, inventory calculations often include a third component. This component is a volume of "ineffective" gas, which is in the storage reservoir but is not adequately connected to the storage system to have a material effect. This ineffective gas volume is referred to as non-effective gas in reports produced by ANR, as discussed in subsequent paragraphs, and has ranged from -0.6 billion cubic feet (BCF) to 1.9 BCF.

Muttonville GSF

For the purposes of this report, we reviewed many of the inventory reports and audits performed at Muttonville GSF since 1988. It is our understanding that a department within ANR conducts an inventory study for all of its operated gas storage fields, and Storage Technical Service (STS) has authored ANR's internal reports since 1996. External engineering consultants have audited each internal report since 1994, or possibly earlier. Dowdle & Associates, Inc. (D&A) has been the firm responsible for these audits since 1995. We were provided and reviewed either an

internal report or an external audit for 1988 and for each year from 1994 to 2021. With these data, we formed a good understanding of how the inventory verification process operates at Muttonville GSF.

Base Gas and Working Gas

With respect to gas-in-place (GIP), base gas, and working gas, the history is reasonably straightforward. As stated in the inventory reports, the original gas-in-place (OGIP) prior to primary production and storage operations is 10.715 BCF of gas. In its 1988 report, ANR estimates a base gas volume of 2.314 BCF and a working gas volume of 11.1 BCF, for a total inventory of 13.4 BCF (2.7 BCF greater than the OGIP). This increase in storage volume has been achieved in large part by operating the field at pressures materially in excess of the original discovery pressure, which is normal practice in this type of storage reservoir and which the field has been certified to do. The discovery pressure is stated in the inventory report as 1,331 psia. The field has spent the majority of its storage operational life above the discovery pressure, peaking at around 1,581 psi, or 250 psi above the discovery pressure. As physics drives reservoir pressure to equalize over time, this nearly 20 percent increase above the discovery pressure increases the risk of gas migration from the original structure, via a structural saddle or permeability feature for example. Pursuant to a Federal Energy Regulatory Commission order in March 1999, there was a transfer of 2.9 BCF of working gas to base gas, which reduced the working gas volume from 11.1 BCF to 8.2 BCF and increased the base gas volume from 2.314 BCF to 5.214 BCF.

History of Inventory Losses

The history of inventory losses at Muttonville GSF is somewhat complex. As described above, operators typically make adjustments to account for losses as they become apparent. This may occur once every few years and seldom occurs more than once a year. Since 2003, ANR has used a multitier system whereby Reasonably Certain losses are applied as corrections to booked inventory and carried forward cumulatively, while less-certain losses are classified as Unresolved Loss/Contingency in one of three subcategories: Probable, Reasonably Possible, or Remote. The less-certain losses are carried in one of these subcategories pending further study. The certainty of the loss could be in question if, for instance, the volumes of injection and withdrawal in a season were relatively small, which could lead to potential errors in extrapolation in inventory volumes. Over time, if categorized and studied losses continue and are determined to be real, the values are eventually recategorized as Reasonably Certain losses and reflected as booked inventory corrections.

There have been two adjustments to booked inventory at Muttonville GSF resulting from loss estimates classified as Reasonably Certain. First, a 0.50 BCF loss correction was applied in 2003 after several years of variance between booked and assessed volumes. The second loss correction was applied in 2016 when losses previously classified as Unresolved Loss/Contingency were promoted to Reasonably Certain and booked as inventory adjustments. In 2011 through 2013, a 0.50 BCF loss was subcategorized as Remote. These volumes were promoted to the Reasonably Possible subcategory in 2014, and carried in the same subcategory in 2015. Following an inventory study and a simulation study, ANR concluded in 2016 that 0.75 BCF of gas was no longer contained in the storage reservoir and was declared "migrated gas". D&A's audit report concurred with that conclusion. Hence, the cumulative Reasonably Certain loss tally through 2021 is 1.25 BCF.

A 0.25 BCF loss was subcategorized as Reasonably Possible in 2018, and these volumes were promoted to the Probable subcategory in 2019 and reduced to 0.15 BCF. In 2020 and 2021, these Probable volumes were increased to 0.7 BCF, then reduced to 0.4 BCF. Therefore, the Reasonably Certain plus Probable cumulative loss tally through 2021 is 1.65 BCF.

Metering

According to ANR, metering errors have possibly impacted Muttonville GSF operations for many years and are the cause of a significant portion of the booked inventory volume overages. As far back as 2003, it was suspected that

there was a valve operational issue that created a pulsation effect that led to false measurement of injection activity. The observation was studied by ANR's Measurement Services group, and the 2012 D&A Inventory Audit states that "work completed this year now has eliminated compressor-pulsation measurement error, previously considered a likely possibility, as an explanation for the recent pressure-content behavior". Elimination of the pulsation metering issues as a cause for the inventory discrepancy likely resulted in the need for the simulation study that eventually led to these volumes being reported as inventory losses in 2016.

Further potential metering issues were mentioned in a 2016 inventory report that stated "STS reports that debris and fluid build-up has recently been identified in field meter runs." The report continues, "Restoration and maintenance of the measurement system is imperative to help resolve what so far have been indications of unexplainable recurring book overage." Despite the resolution of these issues being described as "imperative", they continue to be cited as the possible reason for booked inventory overages. It would be extremely surprising if this is true, given the value of the gas that is being metered, and given that currently (after five years on the books), ANR's other operated facilities do not report similar problems. It is our opinion that the length of time such problems are reported to have persisted is extremely unusual and diminishes the likelihood that they are material.

GEOCHEMICAL ANALYSIS

Typically pipeline gases injected into depleted reservoirs are compositionally (elemental or compound percentages) and isotopically (elements with an equal number of protons but differing numbers of neutrons in their nuclei) distinct from the residual native gas that was originally in the reservoir prior to injection operations. A comparative analysis of different elemental and isotopic percentages within a gas sample often reveals similarities and groupings. Further conclusions can be inferred when changes in composition occur over time as measured in samples from the same source location. Our geochemical analysis determined that the gas currently being produced by the Pilat 1-24 well is dissimilar to native Niagaran gas and dissimilar to stored gas at Muttonville GSF, and therefore likely a mixture of the two. Subsequent to conducting our geochemical analysis review, we were provided a draft copy of a report being prepared by Isotech Laboratories, Inc. (Isotech). After reviewing the draft report, it is our opinion that Isotech's conclusions and our determinations are in reasonable agreement.

Component Trends through Time

Figures 2, 3, and 4 show gas component concentrations through time for methane, propane, and CO_2, respectively. The top portion of each of these graphs shows the Pilat 1-24 well gas production rates for reference. The bottom portion shows the gas component concentration. The typical range of expected or observed values for native gas is shown by a yellow band. The typical range of expected or observed values for storage gas is shown by a blue band. Actual recorded values for samples from the Pilat 1-24 well, Muttonville GSF, and example native production wells are shown as green, blue, and yellow points, respectively.

Figure 2 shows methane concentration through time, and the Pilat 1-24 well samples show a clear progression from the lower native band concentrations toward the higher storage band concentrations. Figure 3 shows propane concentration through time, and the Pilat 1-24 well samples show a progression out of the native band into the area between the native and storage bands. Figure 4 shows CO_2 concentration through time, and the Pilat 1-24 well samples show a progression from the lower end of the native band through the entire band and toward the storage band, though the very latest points appear to show a cutback of the longer-term trend.

Isotope Crossplots

Isotope crossplots can help to discriminate native gas compositions from storage gas compositions by clustering typical native and storage gas regions (Coleman, 1-13). Figures 5 and 6 show isotope crossplots, with recorded values for samples from the Pilat 1-24 well, Muttonville GSF, and example native production wells shown as red,

green, and blue points, respectively. In both of these figures, the Pilat 1-24 well samples plot between the native and the storage gas regions.

GEOLOGIC ANALYSIS

Analysis of seismic data shows that the development of the Niagaran Reef in the area of Muttonville GSF (Muttonville Reef) is distinguishable from the Niagaran Reef in the area of the Pilat 1-24 well (Pilat Reef). Available 2-D seismic lines led to an interpretation of the Pilat 1-24 well having encountered a small individual reef situated south and east of the larger Muttonville Reef development. Two of the lines, Line MG-89-17 and Line R-76-69, provide good imaging of the northern and western portions of the Pilat Reef development, with possible evidence of reefing seen in the eastern line, Line R-76-V-21. These lines indicate a fairly small reef development, potentially in direct connection to the Muttonville Reef or in close proximity to the oil reservoir, as mapped by the operator. The reef could extend to the south, but the low structural relief of the reef seen in the Pilat 1-24 well would tend to indicate a smaller rather than a larger reef development.

Our geologic analysis determined that, though not impossible, it would be very difficult to create a mapped volume that would be sufficient to contain the amount of native gas produced by the Pilat 1-24 well. Reefs are organic buildups of carbonate materials, influenced by changing sea levels and water salinities over thousands of years. Internal development of porosity and permeability, partial or complete destruction of the porosity and permeability, and some level of secondary porosity development due to diagenesis of mineral composition of the reefs all create an interpretation with a non-unique solution. Reefs grow and die based on many factors and can be formed as individual pinnacles or as reef complexes, wherein multiple small reefs grow together and coalesce into a larger reef assemblage. Connectivity of pore space within the reef can vary from none to immediate or strong.

We used the well control and seismic data to generate a depth structure map on the top of the Niagaran Reef porosity (Figure 7) and a net porosity isopach map for the Pilat Reef (Figure 8). The mapped area and volume for our current most likely (P50) interpretation of the Pilat Reef is approximately 112 acres and 925 acre-feet (ac-ft), respectively. Using the petrophysical parameters documented in the historical Ferrara Inter-Correspondence, this reef could contain an estimated 243.3 MMCF of gas if filled to the structural spill point. As the current cumulative gas production from the Pilat 1-24 well is approximately 1.2 BCF (and the well is still capable of production), the produced gas is already almost five times the available mapped GIP. If one were to assume the current cumulative production represented an 85 percent recovery of GIP, then OGIP would be approximately 1.412 BCF; or almost six times the P50 mapped volume. To generate a map that could contain the indicated GIP, the Pilat Reef would have to extend to a much larger area that is partially confined by seismic control and would have to thicken greatly in porosity development and quality.

We have compared different interpretations of the volumetrics of the Pilat area to demonstrate that neither the prior operator (Michigan Wisconsin Pipe Line Company) nor the current operator of Muttonville GSF had any belief that the Pilat 1-24 well was in a reef development near the size indicated by the historical production from the Pilat 1-24 well. As shown on the last row of the following table, the reservoir volume (5,369 ac-ft) needed to contain the amount of gas historically produced by the Pilat 1-24 well (keeping in mind the well could still produce gas if it was returned to production) is much larger than any of the mapped volumes, regardless of who performed the interpretation.

Interpretation	Area (acres)	Net Pay (feet)	Volume (ac-ft)	Average Net Pay (feet)	OGIP[1] (MMCF)
Michigan Wisconsin Pipe Line Company	58.6	17	465	7.9	122.4
ANR	111.0	17	1,564	14.1	411.3
NSAI - P50 Case	112.0	9	925	8.3	243.3
NSAI - P40 Case	112.0	17	1,653	14.8	434.7
NSAI - P10 Case[2]	243.0	-	5,369	22.1	1,412.0

(1) OGIP is calculated using parameters from the Michigan Consolidated Gas Inter-Correspondence letter.
(2) Calculated OGIP required for 1,203 MMCF historical production with 85 percent recovery factor.

The data and analysis indicate that it is more likely than not that natural gas migration into the Pilat Reef structure is occurring. A definitive migration pathway between the Pilat 1-24 well and Muttonville GSF cannot be determined with the current well control, but a reasonable assumption is that the lower portion of the Brown Niagaran Reef has limited connectivity between the Muttonville GSF and Pilat areas. As the Pilat 1-24 well produced gas, the reservoir pressure was drawn down in the reefal area around the well. This lower pressure can cause gas to move from areas of higher pressure to areas of lower pressure, in this case Muttonville GSF and the Pilat Reef, respectively. This gas will migrate at a rate determined by the average pressure differential, the petrophysical properties of the gas-bearing formation, and the fluid content of the pore space through which the gas must move. If a gas saturation already exists in the migration pathway, migration can be rapid. If oil or water fills the pore space, migration can be slower. Once a gas saturation is established, gas moves more easily and rapidly through the formation.

SUMMARY

Based on the data reviewed, it is our expert opinion that it is more likely than not that (1) some of the gas volumes injected into Muttonville GSF did migrate away from the storage field and into the reefal development located in the Pilat 1-24 area, and (2) a portion of the gas produced from the Pilat 1-24 well is as a result of that gas migration. This opinion is primarily predicated on the following observations:

- The Pilat 1-24 well continues to repressurize,
- Muttonville GSF has a history of gas losses, including losses deemed to be migration out of the structure of the field,
- Geochemical analysis shows several trends indicating that the character of gas produced by the Pilat 1-24 well is moving from a native gas character toward a storage gas character, and
- Reasonable geologic mapping cannot generate an interpretation that can contain the amount of gas historically produced by the Pilat 1-24 well, therefore there is a high degree of certainty that there is ongoing gas migration into the Pilat area.

OTHER CONSIDERATIONS

A list of references for the data used in the preparation of this Expert Opinion is included immediately after this discussion. These data were provided by MGI (through attorneys at Marino Law, PLLC) and were accepted as accurate. Supporting work data are on file in our office. We are independent petroleum engineers, geologists, geophysicists, and petrophysicists; we do not own an interest in these properties nor are we employed on a contingent basis.

QUALIFICATIONS

NSAI performs consulting petroleum engineering services under Texas Board of Professional Engineers Registration No. F-2699. The technical persons responsible for preparing the report presented herein meet the requirements regarding qualifications, independence, objectivity, and confidentiality set forth in the Standards Pertaining to the Estimating and Auditing of Oil and Gas Reserves Information promulgated by the Society of Petroleum Engineers.

This Expert Opinion has been prepared by Mr. Derek F. Newton and Mr. Mike K. Norton. Mr. Newton is a Senior Vice President and Mr. Norton is an Associate Geoscientist in NSAI's Houston office at 1301 McKinney Street, Suite 3200, Houston, Texas 77010. Mr. Newton is a Licensed Professional Engineer (Texas Registration No. 97689) and Mr. Norton is a Licensed Professional Geoscientist (Texas Registration No. 441). The curricula vitae for Mr. Newton and Mr. Norton are included following the list of references. For the purposes of this report, Mr. Newton billed the Firm at a rate of $595 per hour and Mr. Norton billed the Firm at a rate of $585 per hour. Additional support staff worked on the project and also billed on an hourly-rate basis.

This document is released for the purpose of designating the experts' mental impressions and opinions and a brief summary of the basis for these and should not be used for general distribution. As in all aspects of oil and gas evaluation, there are uncertainties inherent in the interpretation of engineering and geoscience data. The interpretation put forth in this report is based on the data available at the time the report was written; if additional data becomes available, the authors retain the right to amend or supplement the report. Our conclusions necessarily represent informed professional judgment and are expressed within a reasonable degree of scientific certainty.

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April 14, 2022
Houston, Texas

NETHERLAND, SEWELL & ASSOCIATES, INC.

REFERENCES

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Ferrara, J.A., "Re: Analysis of Possible Gas Migration to Pilat #1-24 Well from Muttonville Field Per Dr. Katz's Request", Inter-Correspondence, addressed to B. Weidman, November 12, 1980.

Hackley, Keith C. and Mark A. McCaffrey, "Summary of the Interpretation of Gas Geochemistry for Samples from Muttonville Gas Storage Site", Isotech Laboratories, Inc., Champaign, Ill., April 11, 2022, pp. 1-49.

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DEREK F. NEWTON

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Education: M.S., Petroleum Engineering, Strathclyde University, Scotland; B.S. (1st), Mechanical Engineering, University College, Cardiff, Wales.

Certifications/Associations: Licensed Professional Engineer in the State of Texas. Member of the Society of Petroleum Engineers.

Derek has been a petroleum engineering consultant at NSAI since 1997. His work includes oil and gas reserves estimation, property evaluations for sales and acquisitions, and field studies on domestic and international properties. Derek uses his expertise with reservoir simulation on field development, gas storage, equity, and enhanced recovery project evaluations. Prior to NSAI, he worked with British Gas Exploration and Production in both Houston and the United Kingdom. Some of the major projects Derek has been involved with are listed below.

PROJECT EXPERIENCE

SIMULATION

Derek has conducted simulation studies not only in support of reserves determinations, but also for single well and field studies and other assessments such as development planning (number, location, style, and timing of wells; compression installation; etc.), equity determinations, gas storage field development, seasonal prediction and containment issues, waterflooding, and enhanced recovery studies. Derek's simulation experience includes:

- Black oil and compositional simulations using Eclipse, VIP/Nexus, CMG IMEX, GEM, and some proprietary systems. These models are often built in-house from NSAI-developed geologic models developed in Petrel or a similar program. Sometimes models are client-supplied and then modified and sensitized to achieve the study objectives.
- Simulation study locations include:
  - USA: GOM shelf and deepwater, California, Colorado, Kansas, Michigan, Oklahoma, and Texas
  - Non-USA: Australia, China, Egypt, Equatorial Guinea, Gabon, India, Kazakhstan, Mexico, New Zealand, Nigeria, Russia, United Kingdom (North Sea), and Uzbekistan
- Geologic settings modeled include single and multi-reservoir, clastics, carbonates (dual porosity/permeability systems), reefs, tight/fractured systems, and high pressure/high temperature systems.
- Simulation study clients include majors such as ExxonMobil and Shell; large independents such as Devon Energy, Hilcorp, Marathon, and Noble Energy; international clients such as Ithaca Energy, Waldorf Production, Lukoil, and Statoil; and utilities such as Atmos Energy, Plains All American, and Southern Star Corporation.

GAS STORAGE

- Performed geocellular model development and reservoir simulation of Brasil Field in the Burgos Basin, northern Mexico, to evaluate gas storage potential.
- Developed a full field simulation of the Columbus III gas storage field in Michigan for the purpose of assessing oil recovery potential in a surrounding oil rim.

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DEREK F. NEWTON
(Continued)

- Developed a full field simulation of the Tri-Cities gas storage field in Texas for a horizontal well development expansion project.
- Evaluated several gas storage fields, including Elk, La Pan, Lake Dallas, New York City, Tri-Cities, and Webb Fields, for inventory verification and to support FERC filings.

NORTH AMERICA

- Conducted various Gulf of Mexico deepwater property evaluations including Condor, Conger, Heidelberg, Neptune, Shenandoah, Stones, Thunder Horse, and Ursa/Princess Fields.
- Conducted various CO_2 enhanced recovery evaluations for fields in Louisiana, Michigan, Texas, and Utah, including East Cowden, Goldsmith, Greater Aneth, Katz, Postle, SACROC, West Ranch, and Yates Fields.
- Evaluated various heavy oil California onshore assets in the LA Basin and San Joaquin Valley. The properties are waterflooded or steamflooded using cyclic or continuous pattern injection methods.

EUROPE

- Evaluated reserves for various developed and undeveloped North Sea oil and gas fields including Alba, Bacchus, Captain, Columbus, Cygnus, Erskine, Goldeneye, and Kraken Fields. These evaluations have covered all sectors of the North Sea for clients such as Ithaca Energy and Waldorf Production.
- Conducted an evaluation of various fields in the East Irish Sea including Asland, Calder, Crossans, Dalton, Darwen, Douglas, Hamilton, Hodder, Kappa, Lennox, Milliom, and Nu Fields.

ASIA

- Completed a study of the PY-3 Field, offshore Cauvery Basin, India, incorporating 3-D seismic, petrophysical, and engineering analyses, as well as reservoir simulation to model field development.
- Conducted an integrated development study of the Chinarevskoye Field in Kazakhstan.
- Performed partial and full field reservoir simulation studies, including full field simulation of the Sazankurak Field in Kazakhstan, for reserves evaluation and water injection program design.
- Evaluated contingent resources for various large gas accumulations in Uzbekistan.

AFRICA

- Built a simulation model for the main reservoirs of the prolific Zafiro Field, offshore Equatorial Guinea. Continue to provide extensive follow-up engineering and simulation support. These models are used for testing various development scenarios.
- Built simulation models for fields in the Etame Marin Permit, offshore Gabon. Results are used for reserves estimation, and the models are also used to perform development scenario sensitivity analyses.

EXPERT WITNESS TESTIMONY

- 2017 - Expert witness in the 343rd Judicial District Court of McMullen County, Texas. Represented Swift Energy in a matter concerning the underground spread of H_2S and CO_2 gas from an injection well.

PRIOR EXPERIENCE

Prior to joining NSAI, Derek worked as a Business Relationship Manager (BRM) and Principal Petroleum Engineer for British Gas Exploration and Production, based variously in Houston and the United Kingdom. As a BRM, he managed the IT support team, providing access to appropriate emerging technologies by establishing an effective technology and projects process. As a reservoir engineer, Derek held many positions, notably as lead subsurface engineer for the Central North Sea area and in particular the Armada project, a $900 million flagship development of a 3-reservoir complex containing gas condensate reserves of 280 million barrels of oil equivalent. When working in Houston, Derek was responsible for reservoir engineering for the West Africa and, subsequently, South America

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DEREK F. NEWTON
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regions. In this capacity he was instrumental in raising Gabon production from a declining 8,000 barrels of oil per day to 15,000 barrels of oil per day. He also worked closely with negotiators and finance personnel and performed economic appraisals for block acquisitions and farm-ins in Angola, Argentina, Bolivia, Cameroon, Congo, Cote d'Ivoire, Egypt, Gabon, and Trinidad.

REFERENCES

J. Lawson Fancher – Peregrine Oil & Gas Holdco, LLC, Houston, Texas
John Horsburgh – Ithaca Energy, Aberdeen, Scotland
Derek Neilson – Waldorf Production, Aberdeen, Scotland
Scott Newcomb – Atmos Energy, Dallas, Texas
Charles McConnell – Southern Star Central Gas Pipeline, Inc., Owensboro, Kentucky
David Bruce Cox – Credit Suisse, Houston, Texas

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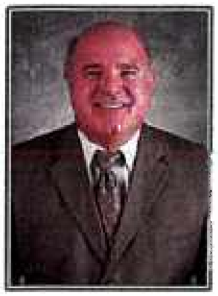

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Mike has been a consulting geoscientist with NSAI since 2020. Prior to his 2020 retirement, Mike was a petroleum geoscience consultant at NSAI since 1989, the Geology Team Leader for the Houston office, and a senior vice president at NSAI. Work products include integrated studies of oil and gas reservoirs ranging from individual reservoir analysis to large regional studies. Mike has prepared subsurface structure and volumetric isopach maps using well logs, rock descriptions, and interpretive cross sections, and integrating 2-D and 3-D seismic data. Mike is also experienced in geocellular modeling. He has been responsible for the presentation of results to clients and financial institutions and expert witness testimony before regulatory and judicial bodies. Mike has significant gas storage experience, with eighteen years of litigation and simulation-driven exposure. Studies performed include hundreds of fields, with major concentration in both onshore and offshore U.S. Gulf Coast; some of the recent major projects Mike has been involved with are listed below.

PROJECT EXPERIENCE

GAS STORAGE

- Conducted a study of Elk City Gas Storage Field in Kansas. Resulted in geocellular model used for simulation of expansion possibilities.
- Performed geologic study resulting in geocellular model of a Niagaran Reef storage field in Michigan. Results input into simulation for enhanced oil recovery development scenarios.
- Performed gas migration study of the Viola Carbonate at Cunningham Gas Storage Field, Kansas, which led to expert witness testimony in federal court and implementation of a horizontal well drilling program to increase peak load deliverability. Involved with the recent design and interpretation of a 3 D seismic program. This field is currently in the process of computer simulation in order to maximize field performance.
- Conducted study of Stuart Gas Storage Field, Oklahoma, which led to testimony before an arbitration panel. This field is in the process of computer simulation in order to maximize operations. Involved with ongoing field remediation work.
- Addressed gas migration issues in study of the Mississippian Chat and Red Fork Sand at Webb Gas Storage Field, Oklahoma. Prepared expert witness testimony in federal court.
- Addressed gas migration issues in study of West Colony Gas Storage Field, Oklahoma, and prepared expert witness testimony for arbitration.
- Performed study of the Arbuckle Dolomite at Lyons Gas Storage Field, Kansas, to satisfy increased reporting requirements implemented by the state regulatory body. Results were incorporated into a full field simulation model.
- Conducted study of Brasil Field in Mexico for conversion to gas storage. Constructed a geocellular model for input into simulation.

NETHERLAND, SEWELL & ASSOCIATES, INC.

MIKE K. NORTON
(Continued)

NORTH AMERICA

- Conducted numerous reserves assessments of properties along the entire Gulf Coast, offshore Gulf of Mexico, Mid-Continent, Rocky Mountains, and California for property sales, acquisitions, financing, and SEC filings.
- Performed gas cycling/blowdown study of Fordoche Field, Louisiana, to determine original and current hydrocarbons in place.
- Incorporated subsurface geology, geophysical interpretation, and complex lithological/petrophysical analysis to resolve performance versus volumetric analysis at North Turtle Bayou Field, Louisiana.
- Studied carbonate facies variations for potential waterflood areas and deep 3-D seismic-based potential in analysis of South Cowden Field, Texas.
- Developed log-based methodology for determining productivity in fractured carbonate at Manderson Field in Wyoming.
- Conducted study of the Leadville Limestone at McElmo Dome CO2 Field, Colorado, for input into a computer simulation for deliverability enhancement by the operator, Shell Exploration & Production Company.
- Performed numerous studies of Jurassic tight gas sand and carbonate plays in East Texas and North Louisiana.
- Extensive experience in carbonate and clastic reservoirs of the Mid-Continent and Michigan Basin regions.
- Extensive experience in tight gas sands of South Texas, including Vicksburg, Wilcox, and Olmos.
- Studied helium resources and reserves in Alberta and Saskatchewan.

INTERNATIONAL

- Performed geologic studies on numerous large Miocene sandstone fields in the Isthmus Saline Basin of Mexico.
- Conducted integrated study of Sazankurak Field in Kazakhstan for computer simulation in order to optimize development.
- Coordinated geological and geophysical study of the fractured carbonate reservoir at West Linapacan Field, Philippines.

EXPERT WITNESS TESTIMONY

- 2017 - Expert witness in an arbitrated matter concerning correlative rights at Kettleman Middle Dome Field, Kings County, California.
- 2011 - Expert witness in the 17th Judicial District Court, Lafourche Parish, Louisiana. Prepared testimony for the defendant in the matter of Stephen E. Coignet, et al. vs. Stone Energy.
- 2011 - Prepared testimony on behalf of Southern Star Central Gas Pipeline, Inc. for the purpose of disputing an application presented by an outside oil and gas operator to the Kansas Corporation Commission for commingling at the Alden Gas Storage Field.
- 2005 - Expert witness in United States Federal District Court, Wichita, Kansas. Represented Northern Natural Gas Company in matters concerning migration of storage gas at Cunningham Gas Storage Field, Kansas.
- 2003 - Expert witness in United States District Court, Oklahoma City, Oklahoma. Represented Southern Star Central Gas Pipeline, Inc. in matters concerning migration and fair market value.
- 2001 - Expert witness representing Enogex Inc. in an arbitrated matter concerning Southwest Stuart Gas Storage Field, Hughes County, Oklahoma.
- 2000 - Expert witness representing Williams Gas in an arbitrated matter concerning migration issues and fair market valuations at West Colony Gas Storage Field, Anderson County, Kansas.
- 1997 - Expert witness in United States District Court, Wichita, Kansas. Represented Northern Natural Gas Company in matters concerning the expansion of Cunningham Gas Storage Field, Pratt County, Kansas (Beck versus Northern Natural Gas).

NSAI NETHERLAND, SEWELL & ASSOCIATES, INC.

MIKE K. NORTON
(Continued)

- 1996 - Expert witness before the Kansas Corporation Commission concerning unitization for waterflood implementation at Stevens Field, Meade County, Kansas.
- 1995 - Prepared expert witness testimony and exhibits on behalf of Northern Natural Gas Company to be submitted to the Kansas Corporation Commission. Testimony concerned migration issues at Cunningham Gas Storage Field, Pratt County, Kansas. Testimony resulted in approval for expansion of the certificated storage formation. Testimony was also reviewed by the Federal Energy Regulatory Commission, and expansion was approved administratively by that body.

PRIOR EXPERIENCE

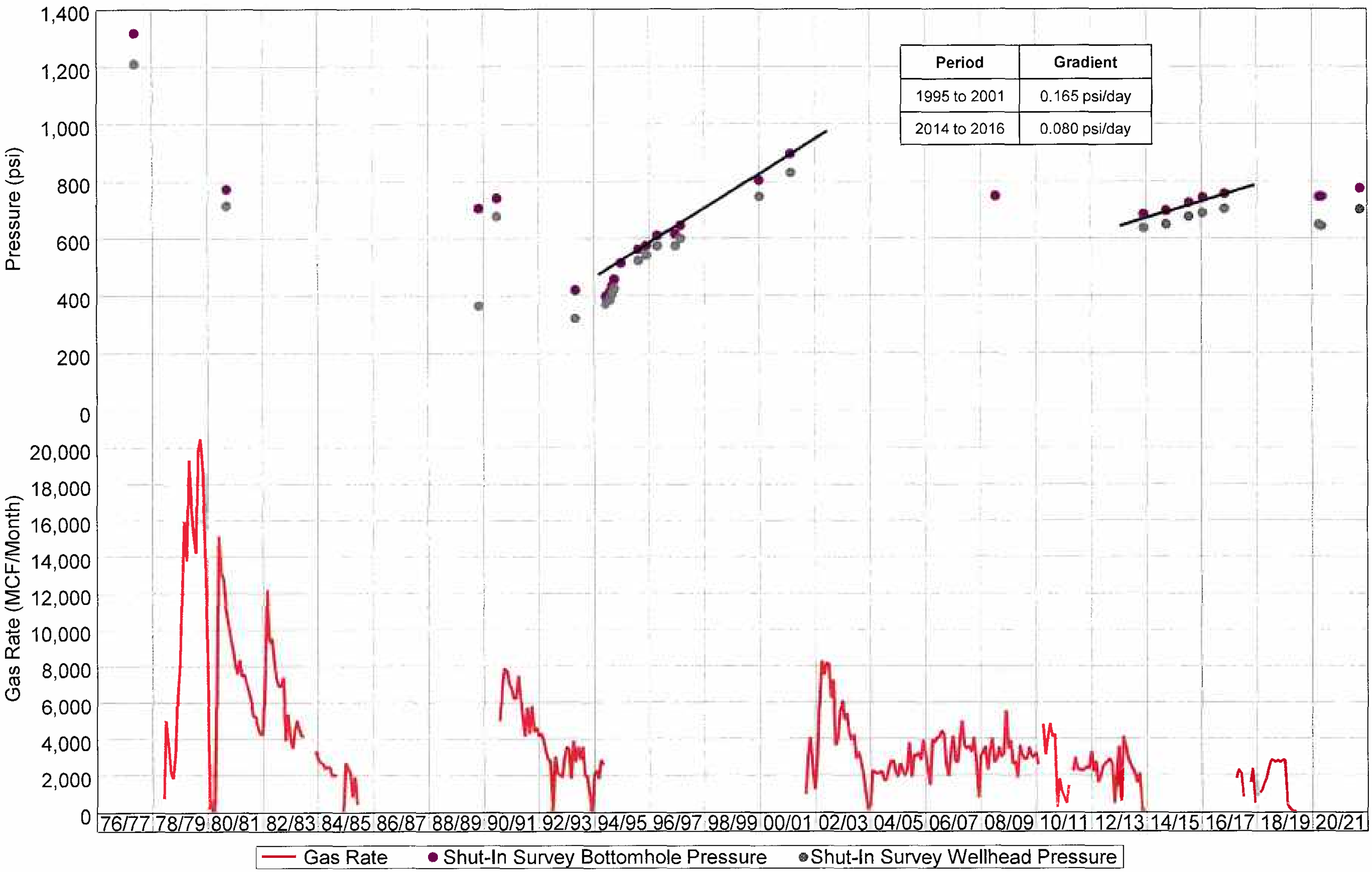
Mike's prior work experience includes over ten years of exploitation and exploration work, predominately in the U.S. Gulf Coast and Mid-Continent regions. Initial work experience was in a management position with Seispros, Inc., Houston, working in seismic data acquisition in South Texas. From 1979 to 1982, Mike held development and exploration positions with Moore McCormack Energy, Dallas, where he performed regional exploration work focusing primarily on Jurassic carbonate and sandstone trends. Duties also included screening outside-generated prospects and showing original prospects to prospective industry partners, serving as wellsite geologist on all division wells, making recommendations on development drilling and workovers, and working with engineering department on reserves reporting. From 1982 to 1983, he was Manager of Development Geology, Soltex Oil & Gas, Dallas, where he was responsible for mapping, evaluating, and making recommendations on a large number of properties brought together when the company was formed in 1981. From 1983 to 1985, Mike was Geological Manager at Tracy Engineering Company, Dallas, and responsible for all geologic operations. From 1985 to 1989, he was an Independent Consulting Geologist providing geologic support for reservoir studies conducted by NSAI and William Cobb & Associates. He also worked with numerous small operating companies performing exploration and exploitation geology, including evaluating producing and prospective acreage, screening prospects, and making drilling and completion recommendations.

REFERENCES

Chris Jacobsen - Oak Ridge Natural Resources, LLC
Maurice Gilbert - Sempra Energy, Houston, Texas
Charles McConnell - Southern Star Central Gas Pipeline, Inc., Owensboro, Kentucky
Jeff Kennedy - Martin, Pringle, Oliver, Wallace & Swartz, L.L.P., Wichita, Kansas
Mike Smith - Hall, Estill, Hardwick, Gable, Golden & Nelson, P.C., Oklahoma City, Oklahoma
Ann T. Rider - Brown, Dengler, Good & Rider, L.C., Wichita, Kansas
Mark Coldiron - McKinney & Stringer, P.C., Oklahoma City, Oklahoma
Robin Fields - Conner & Winters, LLP., Oklahoma City, Oklahoma
David Iverson - Kayne Anderson Capital Advisors, Houston, Texas
David Bruce Cox - Credit Suisse, Houston, Texas

NETHERLAND, SEWELL & ASSOCIATES, INC.

PILAT 1-24 GAS PRODUCTION AND PRESSURES
MACOMB COUNTY, MICHIGAN



Period	Gradient
1995 to 2001	0.165 psi/day
2014 to 2016	0.080 psi/day

Figure 1

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NETHERLAND, SEWELL & ASSOCIATES, INC.

AVERAGE DAILY GAS PRODUCTION AND METHANE CONTENT VERSUS TIME
MACOMB COUNTY, MICHIGAN

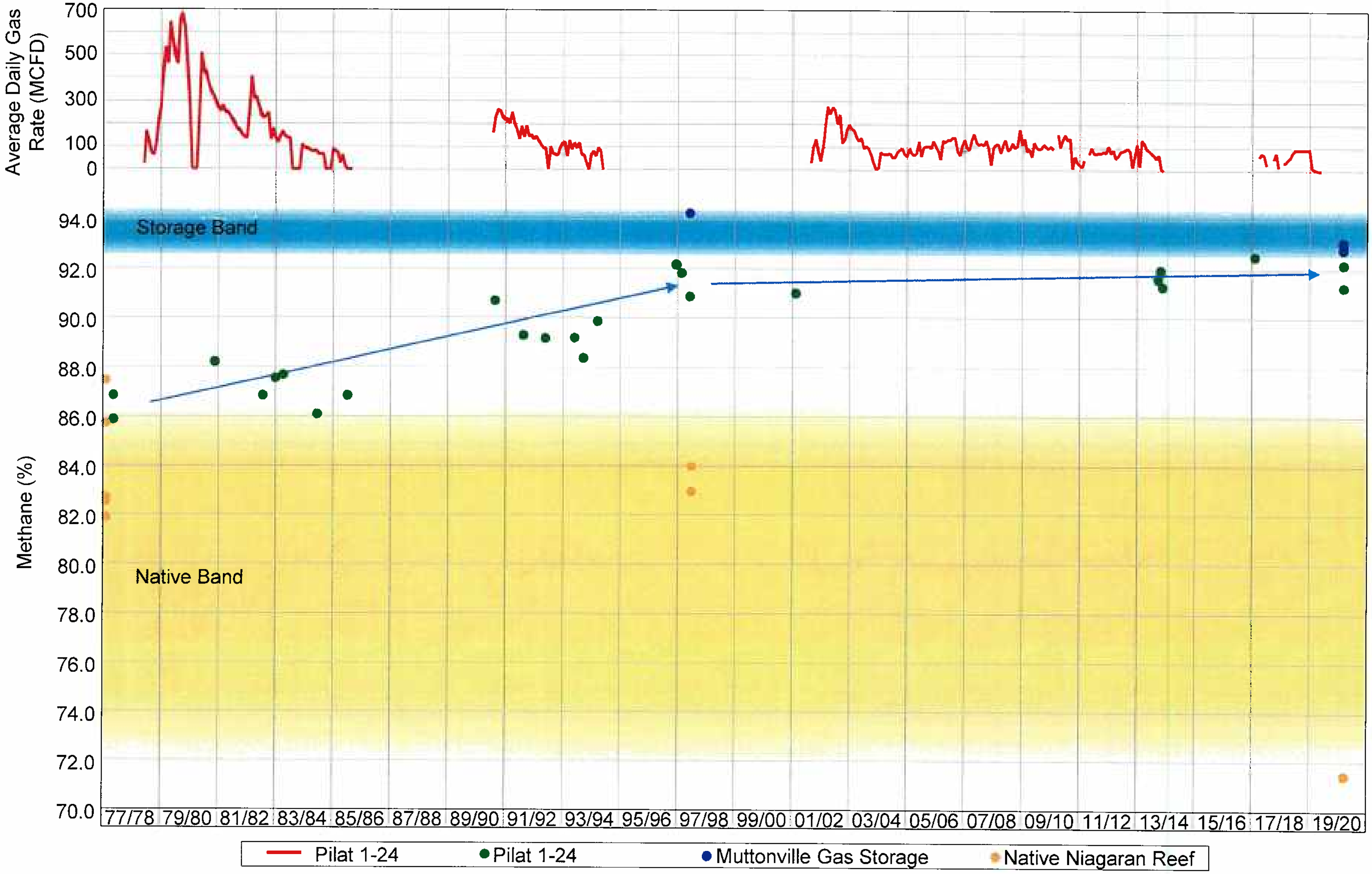


Figure 2

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NETHERLAND, SEWELL & ASSOCIATES, INC.

AVERAGE DAILY GAS PRODUCTION AND PROPANE CONTENT VERSUS TIME
MACOMB COUNTY, MICHIGAN

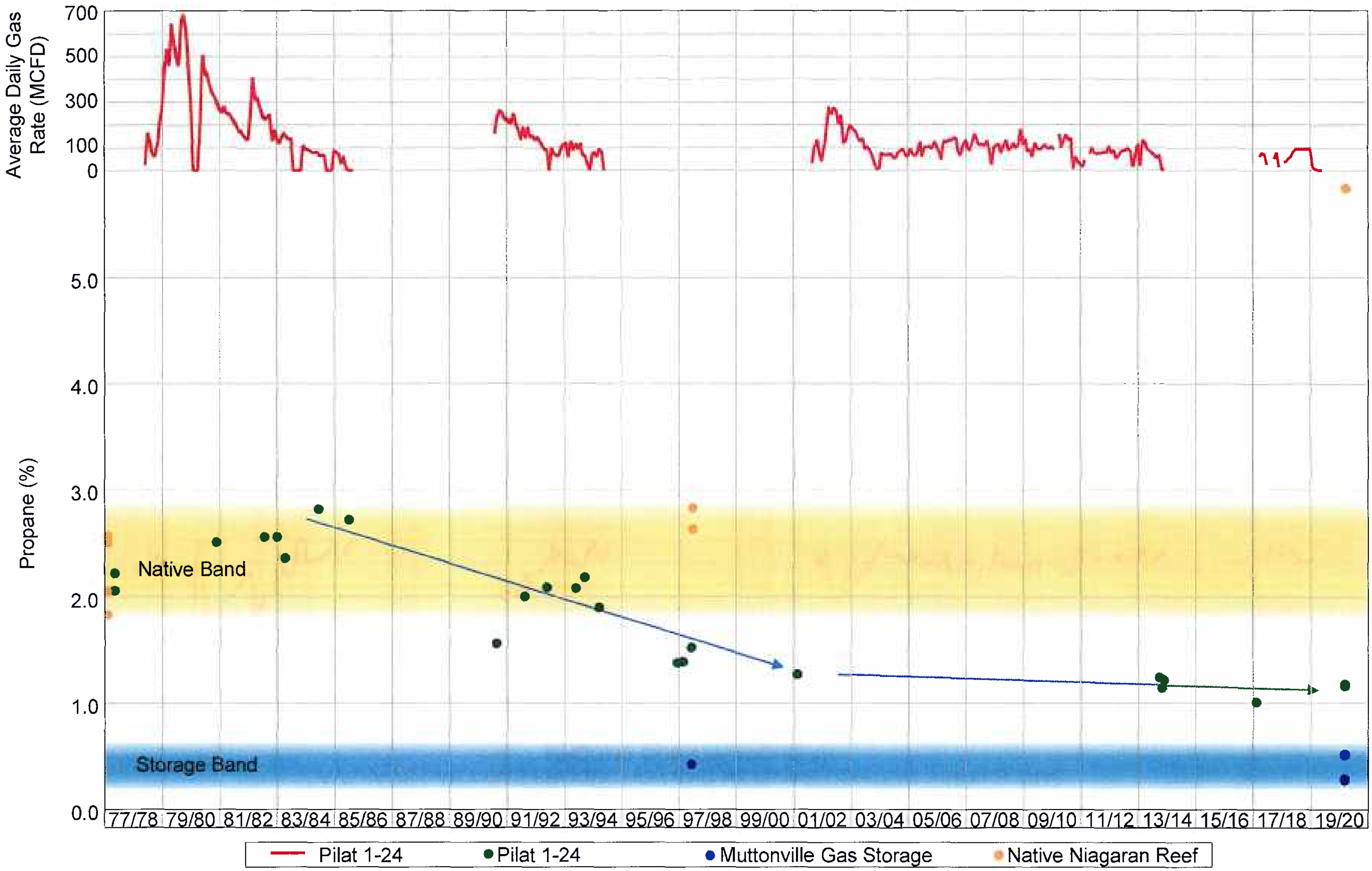


Figure 3

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NETHERLAND, SEWELL & ASSOCIATES, INC.

AVERAGE DAILY GAS PRODUCTION AND CO_2 CONTENT VERSUS TIME
MACOMB COUNTY, MICHIGAN

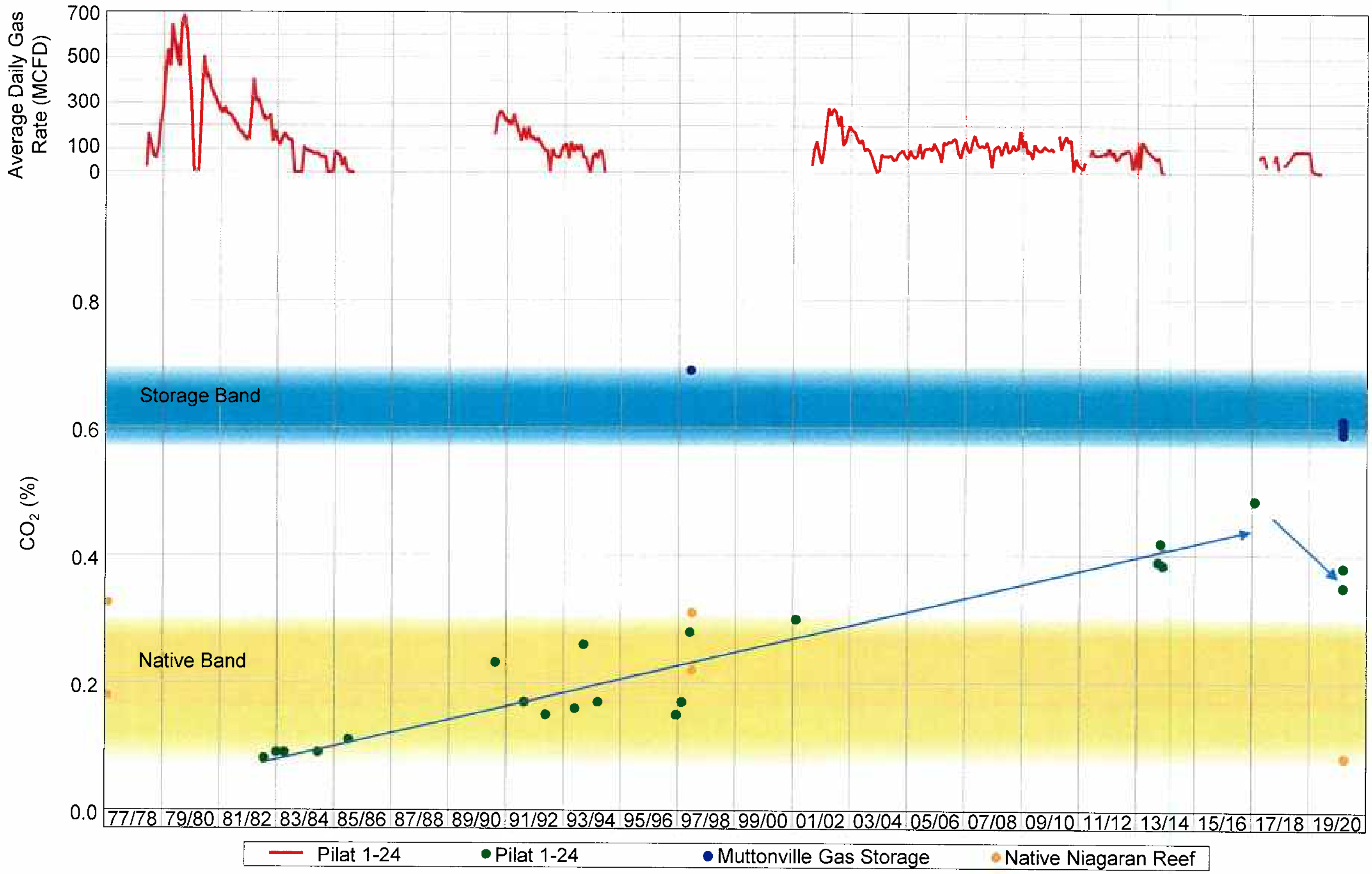


Figure 4

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NSAI NETHERLAND, SEWELL & ASSOCIATES, INC.

CHEMICAL AND CARBON ISOTOPIC COMPOSITIONAL RANGES
MACOMB COUNTY, MICHIGAN

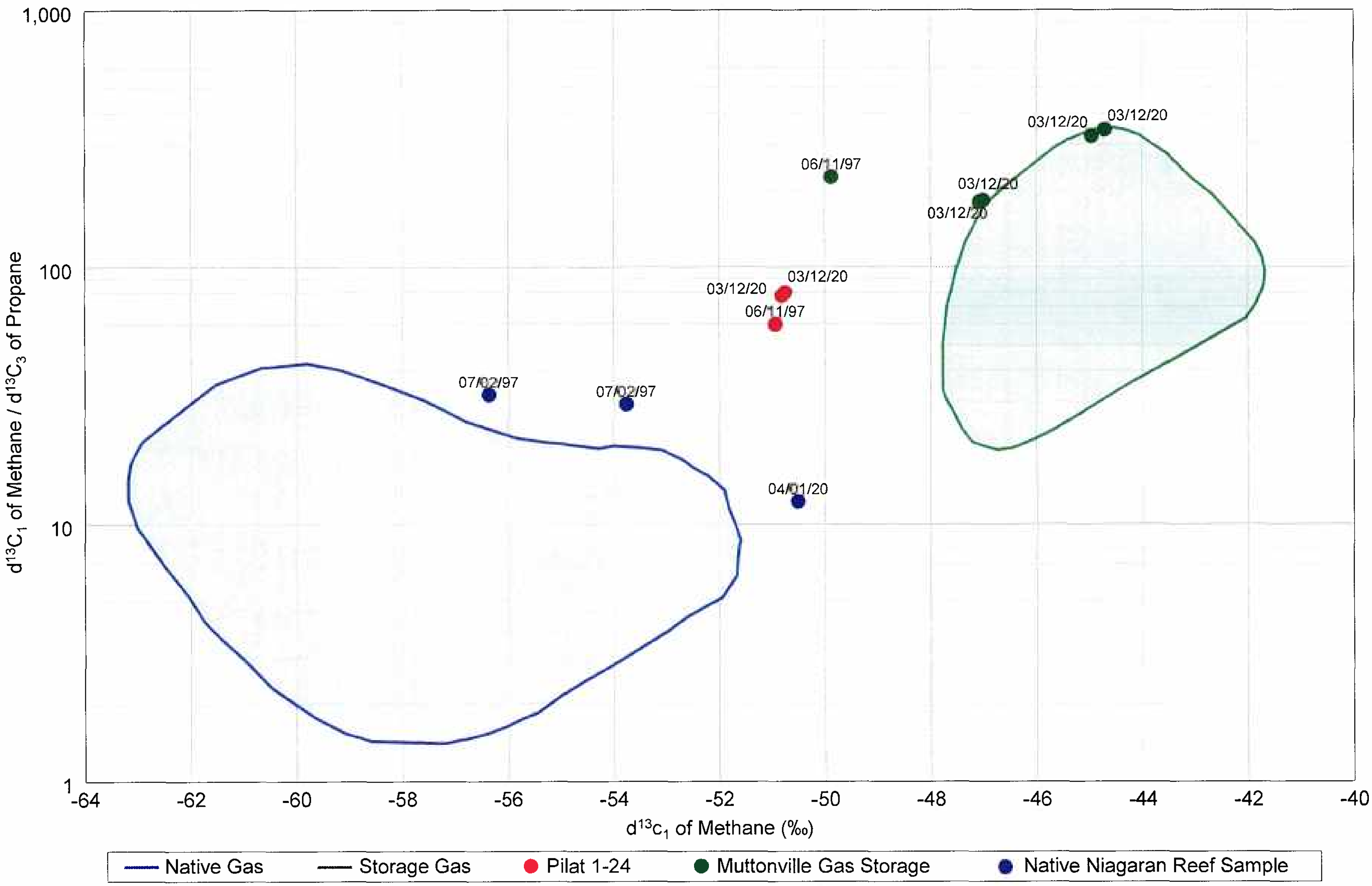


Figure 5

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NETHERLAND, SEWELL & ASSOCIATES, INC.

CARBON ISOTOPIC COMPOSITION OF METHANE AND ETHANE
MACOMB COUNTY, MICHIGAN

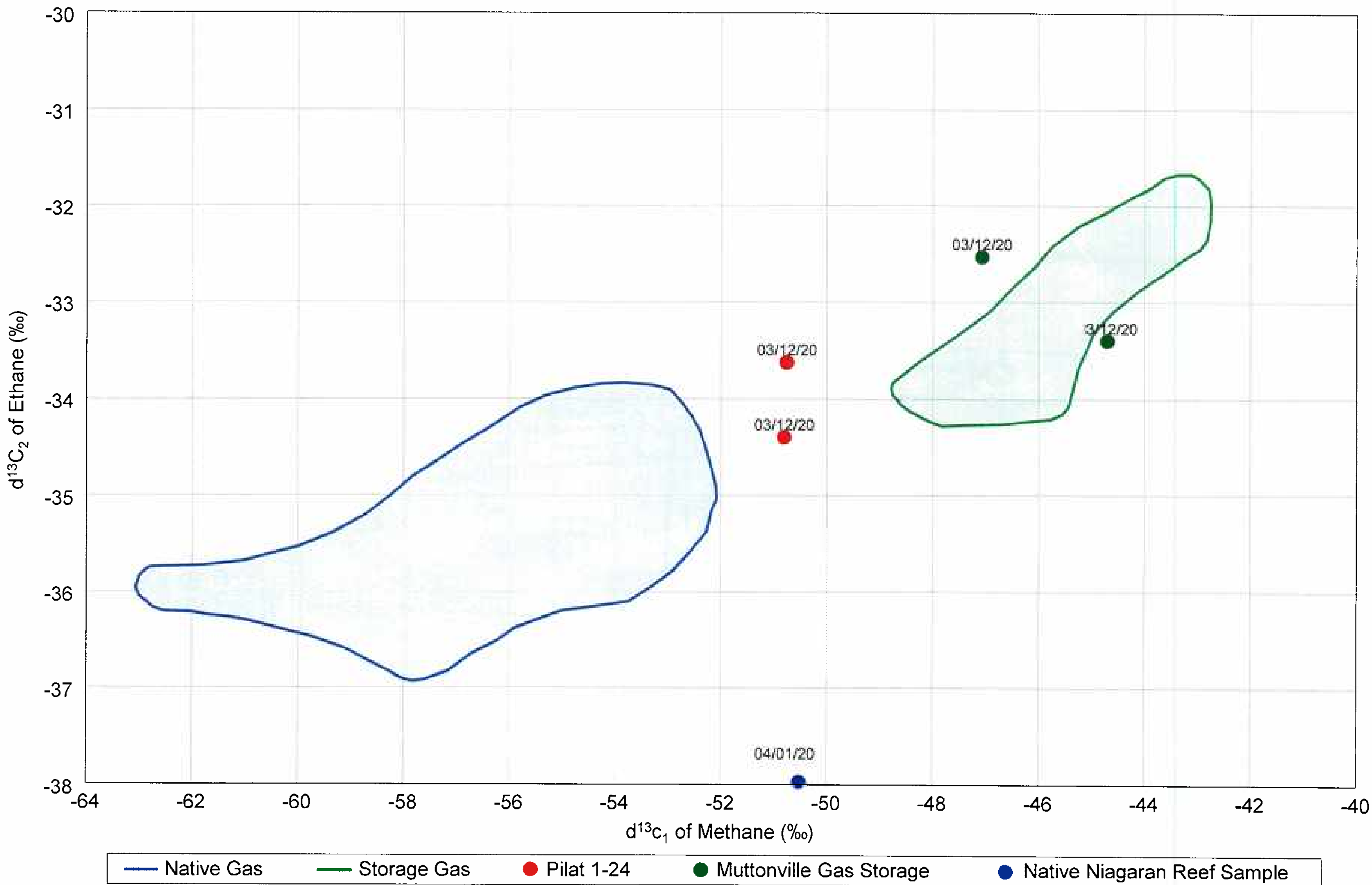
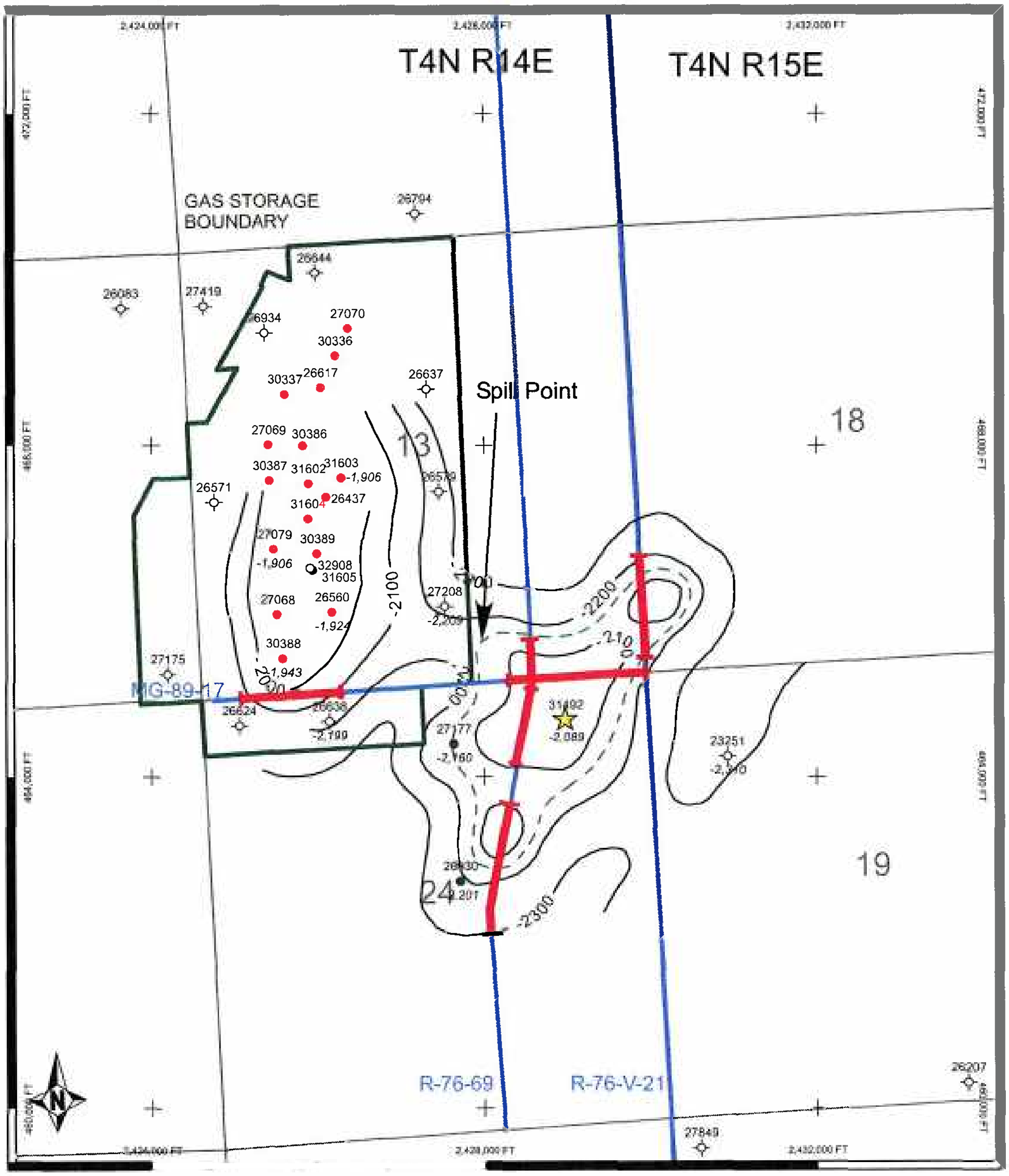


Figure 6

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

NETHERLAND, SEWELL & ASSOCIATES, INC.



Legend

- Reef Signature 2-D Seismic
- Extent of 2-D Seismic Data
- Gas Storage Boundary
- Well of Interest: Pilat 1-24
- Gas Storage Well
- Observation Well
- Oil Well
- Dry Hole

Muttonville Gas Storage Field
Macomb County, Michigan

Depth Structure
Top Niagaran Reef Porosity

Contour Interval: 100 feet

SCALE IN FEET
0 1,000 2,000 4,000

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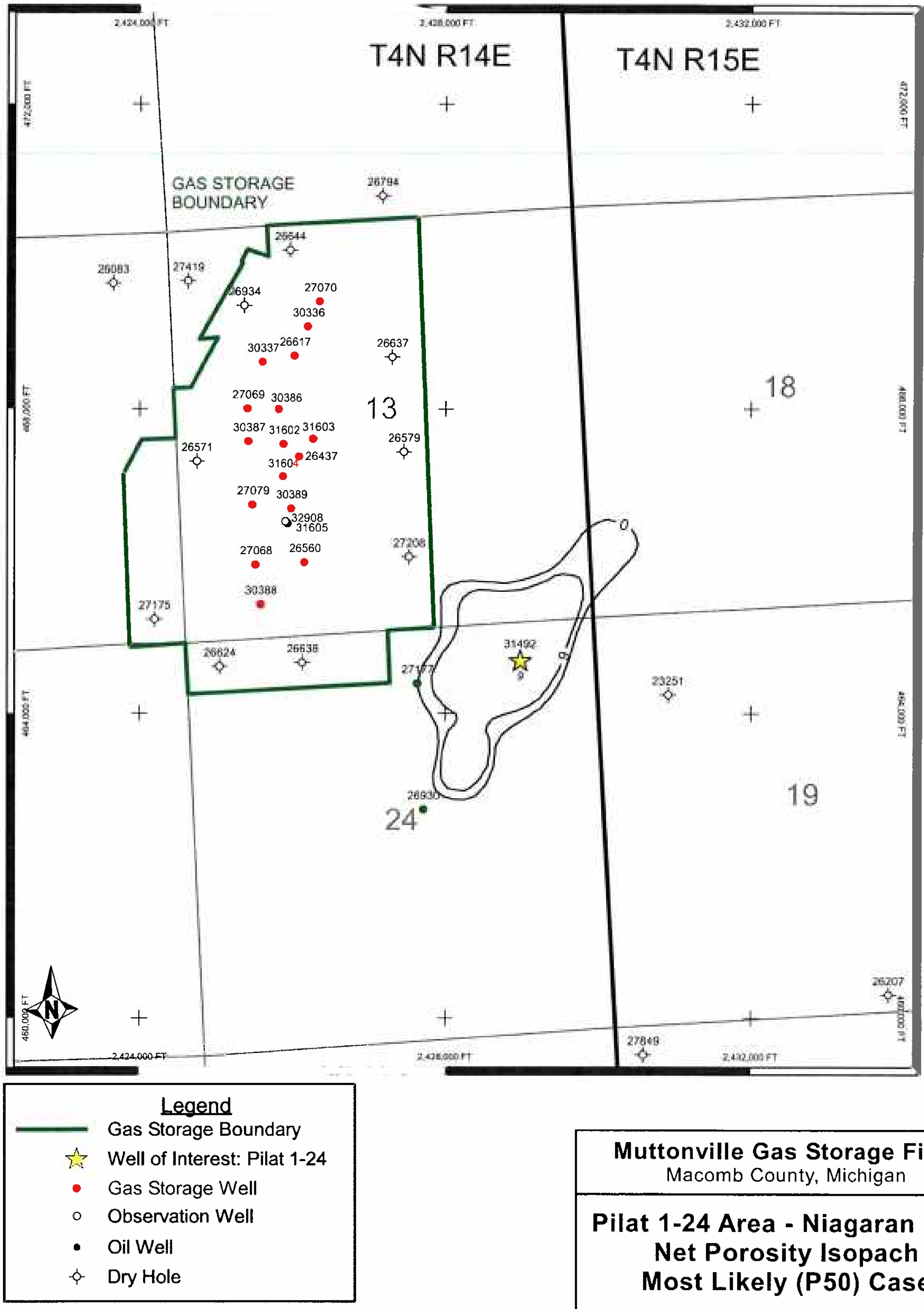
NETHERLAND, SEWELL & ASSOCIATES, INC.



Muttonville Gas Storage Field
Macomb County, Michigan

Pilat 1-24 Area - Niagaran Reef
Net Porosity Isopach
Most Likely (P50) Case

Contour Interval: 9 feet

SCALE IN FEET

0 1,000 2,000 4,000